A NOTE ON DYAR'S LAW (LEPIDOPTERA: LARVAE).

By Wm. T. M. Forbes, Department of Entomology, Cornell University, Ithaca, New York.

It has been generally recognized that the chitinous parts of the successive stages of an insect tend to increase at each molt in constant ratio. In the caterpillar the most convenient part to measure is the width of the head, and the ratio between head widths at successive molts is known as Dyar's ratio.[1]

There is still much room for study of the exceptions and irregularities in this law. A common condition is that one sex should have a stage more than the other, where it is much larger in the adult; and this seems to be the case in the tussock caterpillars (*Hemerocampa*). Another common variation is that one of the regular stages should be omitted, giving a double ratio for one molt and a total number of stages one less; or in contrast there may be an additional stage interpolated, giving a half ratio for two successive molts.[2] Finally the law may be less rigidly carried out, and we get a variable head size, depending on the food supply or some other unknown factor. The latter group of cases have not been analysed as yet, and cannot be solved by the simple attack of making a few scattered measurements of single larvae, or even carrying a stray larva or two through its series of stages.

A recent paper at last gives us some data on a case of this type.[3] The black or greasy cutworm (*Agrotis ypsilon*), which must be carefully discriminated from the black or black army cutworm of

[1] Dyar, Psyche v. 420–422, 1890; see also Imms, Text-Book of Entomology, 183.

[2] Dyar gives a striking example of skipped stages in Psyche vi 146, 316. *Apatelodes torrefacta* shows the ratio 1.26, which should indicate eight stages: one larva measured had the sizes .65, .8, 1.3, 2.2, 3.3 mm. omitting stages 3, 5 and 7; while another showed the measurements 1.3, 1.6, 2.1, 2.6 and 3.2 mm., showing all the stages in the part of the development obtained. On the other hand, there are many cases of an interpolated stage, *e.g., Stretchia plusiiformis* and *Syneda howlandi* in Dyar's report on Colorado Lepidoptera, Proc. U. S. Nat. Mus. xxv: 377. In the former the stages are .4, .6, 1.0, 1.5 (1.8) and 2.3 mm., the next to last stage interpolated in one case, with ratios half the usual; in the latter the series is .4, .6, 1.0 (1.3), 1.5, 2.3 and over 3 mm., the interpolated stage occurring between the normal third and fourth.

[3] Satterthwait, Jour. Agr. Res. xlvi, 517 ff.

the North (*A. fennica*), has a variable number of stages, 6 or 7, rarely 8. We find that specimens with the larger number of molts grow hardly larger (fig. 1), though Satterthwait's tables 6 and 7 indicate that the ones with 7 stages consume from 7 to 10 per cent more food, sex for sex, than those with 6.

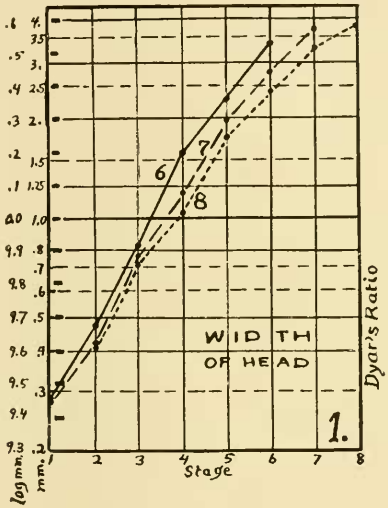

FIG. 1.

In Fig. 1 I have plotted the head-sizes given in Satterthwait's table 1; using a logarithmic scale, so that a straight line will indicate a steady percentage increase in size. It is noticeable that in this case the final size (upper ends of lines) is about the same with all three sets, and that each line is fairly straight, with some falling off at the top, indicating a slower increase in the last 2 or 3 stages. Also the molts are about evenly spaced on each line, indicating that instead of interpolating a stage to make the larger number, or jumping a stage to make the smaller number, each number of stages is foreshadowed from the first molt.

If we plot these ratios (Fig. 2) we find that as before, the ratio of growth is lower for each added stage, but the irregularities are such that the difference in the first three stages may not mean anything. What is striking is a large jump in head-size at the third molt, for those which are only going to have six stages, the head practically doubling in diameter—and a somewhat smaller special increase in the following molt. It appears on the face of the record

that whatever makes the difference between the six and seven stage cycles occurs shortly before the third molt.

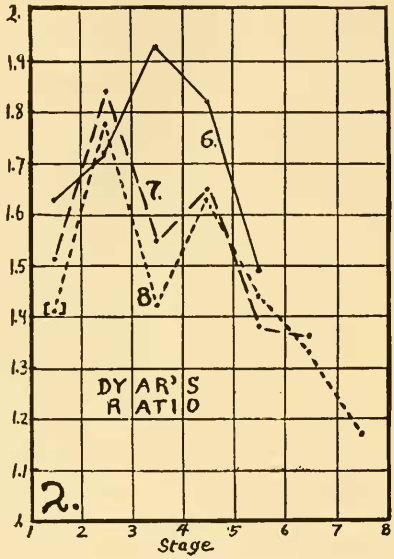

FIG. 2.

Dyar's ratios calculate as follows:

Stage	6 stages	7 stages	8 stages
1–2	1.63	1.51	(1.41)
2–3	1.72	1.84	1.78
3–4	1.93	1.55	1.42
4–5	1.82	1.65	1.63
5–6	1.49	1.38	1.44
6–7		1.36	1.33
7–8			1.17
Average	1.72	1.55	1.45
Av. 1–5	1.77	1.64	1.56
Av. rest	1.49	1.37	1.21

Unfortunately no protocols are given so that it is not possible to say if this jump is due to a general increase of head size in the entire lot, or to the averaging in of a group of specimens that

skipped a molt at this point, with others that skipped one at some later stage.

Both the curve, and the figures of average Dyar's ratios indicate that growth falls off in the later stages (after the fifth). This species has an unusually small egg in proportion to its adult size, and it would appear that the earlier stages show abnormally large increments of growth, while the later ones are more normal. It is considered most typical for an insect to double in volume at each molt, which would indicate a Dyar's ratio of only 1.26; but somewhat higher ratios are more common in the caterpillars. The averages given for the later stages: 1.49, 1.37, 1.21, are within the normal range.

Synonymy of two North American Mycetophilidae (Diptera).—A specimen of *Mycetophila* (*Opistholoba*) *ocellata* Joh. (1912) has been compared by Dr. F. W. Edwards, of the British Museum, with the European *M. caudata* Staeger (1840) and found to be identical. Landrock in Lindner's "Die Fliegen der palaearktischen Region" places *Exechia casta* Joh. (1912) as a synonym of *Exechia frigida* (Holm. 1865).—O. A. Johannsen, Ithaca, N. Y.